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RESIN INFILTRATE VERSUS COMPOMER AS PIT AND FISSURE SEALANTS OF PRIMARY TEETH: A RANDOMIZED CONTROLLED CLINICAL TRIAL

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ABSTRACT

This study designed for the purpose of studying the Resin infiltration system in the form of ICON DMG® versus Compomer in the form of Compoglass Flow Ivoclar Vivadent® regarding their antibacterial effect against streptococcus mutans, clinical retention and their radiographic changes on underlying enamel and dentin when they both used as pits and fissure sealant

Methodology: two hundred second primary molars from one hundred children were selected to deliver the two materials in the form of fissure sealant. They arranged in two groups. Both ICON and Compoglass flow applied in contra lateral sides according to the principles of split mouth technique design. The tested materials applied according to the manufacture instructions without modification for their technique of application.

Result: Statistical analysis of the microbilogical and clinical data showed that Compoglass flow exhibits superior antibacterial results against streptococcus mutans and less bacterial adhesion were recorded on its surface compared to the -number of bacterial colonies adhered to the fissures sealed with ICON. These results attributed to the fluoride releasing power of Compoglass flow which has an obvious antibacterial action and affect the bacterial community.

Meanwhile the statistical analysis of clinical retention scores of both materials reveled superior retention ability of ICON over Compoglass flow along the whole follow up periods.

Conclusion: Compomer (Compoglass flow) has superior antibacterial effect against streptococcus mutans superior to resin infiltration (ICON). Resin infiltration (ICON) has a better clinical retention as a fissure sealant than Compomer (Compoglass flow).

KEYWORDS: Resin infiltrate, Compomer, Strptococcus mutans, Pit and fissure sealant, Primary molar

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INTRODUCTION

There is a clear relationship between dental caries and mutans streptococci. After the dental eruption, these microorganisms colonize different tooth surfaces. Fissures form a good reservoir, and even when they are not carious, they harbor mutans streptococci. The high carious susceptibility of the occlusal surface is inherent in its morphology. The pits and fissures, which form mechanical retention niches for bacteria, food, and other debris, allow the initiations of enamel demineralization. Although only 12.5% of all tooth surfaces are occlusal, these surfaces develop more than two-thirds of total caries experienced in children.[1] A preventive measure such as control of bacterial plaque and topical application of fluoride solutions have little effect on these surfaces, more effective measures are therefore necessary, such as the application of occlusal sealants. The rationale of using sealants is to penetrate and seal caries–prone pits and fissures transforming them into non-retentive surfaces and acting as a physical barrier from the oral environment. As a result, the Cariogenic microorganisms present in these fissures lose their viability. It has been suggested that this positive effect could be enhanced by adding fluoride to the sealant material.[2] Caries infiltration is the new era in conservative dentistry, the resin infiltration technique aims to allow its penetration by capillarity into the porous enamel, stopping the demineralization process, stabilizing the caries lesion, and forming a mechanical barrier, depriving the bacteria that colonize the lesion of the oral biofilm nutrients.[3,4] The capacity of a sealant to prevent dental decay relies directly upon the ability of the sealant material to thoroughly fill pits, fissures, and/or morphological defects and remain completely intact and bonded to enamel surfaces for a lifetime. The success of fissure sealants depends on the sealant retention, maintenance of integrity, and the properties of the sealant materials.[5] Because occlusal sealing is the most effective method for caries prevention on pit and fissure surfaces. The present study was carried out to investigate two different materials regarding the influence of sealant type on Streptococcus mutans count in plaque and their clinical retention. The antibacterial effect and clinical retention of the two pit and fissure sealants were evaluated at three and six months respectively.

Aim of the study: The present study aimed to assess the clinical and antibacterial effectiveness of resin infiltrate versus Compomers as pit and fissure sealants.

Study design: Split-mouth randomized controlled clinical trial study on sound lower primary molars. Two hundred primary molars from 100 children ranging from four to six years of age were selected for the study with the following inclusion criteria:

- Healthy children free of any systemic disease or any developmental disturbances of the teeth and jaws that would have affected dietary patterns, caries susceptibility,
- No history of antibiotic intake for the past 2 weeks
- No history of fluoride treatment for the past 2 weeks.

Exclusion criteria include the following:

- Children with fillings in the selected teeth.
- Children with sealants in the selected teeth.
- Children with clinical evidence of caries in the selected teeth either white spot lesion or cavities.
- Children with an allergy to any drug, such as resin restorative material and glass ionomer.
- Children with Extremely poor oral hygiene.
- Children with periodontal disease.

Subjects grouping: The two hundred primary molars arranged in two groups. Group A: consists of 100 teeth from one side will receive compomer and Group B: consists of 100 teeth from the other side will receive the resin infiltration ICON®.

Method of randomization between two materials: the side of the coin determines the assignment of each material. The figure was used for resin infiltrate, while the other side was used for compomer.

Procedure: Polishing of the subjected teeth is carried out using pumice polishing powder in prophyjet*. The prophylactic polishing powder* consists of sodium bicarbonate with particle size < 0.115. Rubber dam** was used for isolation of the subjected teeth. The single tooth isolation technique was the technique of choice in most cases.

Application of resin infiltration (ICON®)***

The sealant material was applied according to the manufacture's instructions without any modification in the technique. The cleaned fissure was etched using Icon-Etch in its special syringe for 2 minutes. Then the tooth was rinsed off using water for at least 30 seconds and dried with oil-free and water-free air**.** Followed by application of the Icon-Dry applied into the fissure and let sit for 30 seconds. The excess of the Icon-Dry was removed and dried with oil-free and water-free air. Away from the direct light of the dental unit, an ample amount of Icon-Infiltrate is applied into the fissure and let sit for 3 minutes. After excess removal, it was light-cured for 40 seconds using a led light cure device with 1600 wat power. A second layer of the Icon-Infiltrate was applied and cured in the same way.

Application of compomer (Compoglass® Flow)**:** Compoglass® Flow applied from its compule directly into the cleaned fissure. After removal of the excess, the material cured using a light cure device with 1600-watt power.

Microbiological sample for both groups: after removal of the rubber dam, the child was asked to rinse his mouth with water then the first microbiological sample (baseline) was collected by sterile intraoral swab from the occlusal surface and the sealed fissures. Samples were preserved in a screw-capped sterile test tube containing 9 ml Thioglycolate broth medium***** as a transfer medium and immediately sent to the microbiological laboratory for further evaluation. After one month's recall, another sample was gathered and the same step was done for the final sample after 3 months.

Microbiological analysis:[9] The swabs were collected immediately after application of the fissure sealant, 1 month and 3 months after application. Swabs were taken from the occlusal surface utilizing the tips of sterile pieces of cotton. All specimens were transported as soon as possible to the microbiological lab at the microbiology department, faculty of medicine, Al-Azhar University for culture on selective media. For determining Streptococcus mutans salivary levels[10], mitis salivarius****** with bacitracin, agar was used according to the manufacturer's instructions. Normal saline containing the specimens were dispersed by agitation in a vortex mixer at maximum speed for 60 seconds. Homogenized specimens were serially diluted down to10^{-5} in sterile normal saline. From the last dilution tubes, 1 ml aliquots were aseptically spread with a sterile bent-glass rod on plates containing nutrient agar culturing medium. The inoculated plates were then placed in an anaerobic jar containing a gas pack and incubated for 2-4 days at 37°C. The number of *S. mutans* per milliliter of saliva was estimated by comparing the colony density on the growth substrate.

* Dentsply, United Kingdom
** Hygienic, USA
*** DMG America LLC www.dmg-america.com, USA
**** Ivoclar Vivadent www.ivoclarvivadent.com Germany
***** HiMedia, USA
****** Becton Dickinson and DIFCO Company, Chicago, USA

A Quebec colony counter was used. The number of bacteria (CFU) per milliliter or gram of sample was calculated by dividing the number of colonies by the dilution factor multiplied by the amount of specimen added to liquefied agar.

$$\frac{\text{Number of colonies (CFUs)}}{\text{Dilution X amount plated.}} = \text{number of bacteria/ml}$$

Clinical evaluation: Clinical evaluations were done 3 and 6 months after sealant application. The following criteria were adopted to evaluate the retention of the sealant according to Pereira A et al: [6]

- Total Retention (TR) – score 0: total retention of sealant on the occlusal surface.
- Partial Retention Type 1 (PR1) – score 1: the presence of sealant in 2/3 of the pit extension, with small fractures and losses of material.
- Partial Retention Type 2 (PR2) – score 2: the presence of sealant in 1/3 of the pit extension with fractures and losses of material.
- Total Loss (TL) – score 3: the absence of sealant on the occlusal surface.

The following criteria were used to evaluate occlusal caries in the sealed teeth (adapted from Thylstrup and Fejerskov[7] and Ketley and Holt:[8]

- No visible caries.
- Presence of an active white spot lesion (translucent enamel alterations on occlusal surfaces of the teeth that received sealants.
- Presence of a microcavity (diameter ≤1.5 mm across fissure and large cavities.
- Filled teeth.

Using dental prob the integrity of the sealant was explored and checked after At 3 and 6 months intervals from baseline**.**

Statistical analysis:

IBM® SPSS® Statistics Version 20 was used for data management and data analysis. Bacterial counts were transformed to log values to be normally distributed (avoid high variability). The analysis was done on log values and description was made by the mean and standard deviation. Repeated measures ANOVA was done to elicit time effect within each group and to verify if there is any difference in the rate of drop of bacterial count over time between the two groups what is called time and group interaction. For parametric data, Repeated measure ANOVA followed by Tukey post hoc test was used to compare between more than two groups in related samples. An independent sample t-test was used to compare between two groups in non-related samples. For non-parametric data, Mann Whitney test was used to compare between two groups in non-related samples. Wilcoxon was used to comparing between two groups in related samples. P-value sets to be significant at ≤ 0.05 levels

RESULTS

TABLE (1) Comparison between the S.M counts of both groups during all the follow-up periods.

Variables	Baseline		After 1 month		After 3 months		p-value
	Mean	SD	Mean	SD	Mean	SD	
Icon	4.07^{aB}	0.09	4.11^{aA}	0.09	4.24^{aAB}	0.35	0.030*
Compomer	3.60^{aA}	1.32	3.80^{bA}	0.35	3.91^{bA}	0.11	0.456ns
p-value	0.277ns		0.014*		0.010*		

Means with different small letters in the same column indicate a statistically significant difference; means with different capital letters in the same row indicate a statistically significant difference. *; significant (p<0.05). ns; non-significant (p>0.05).

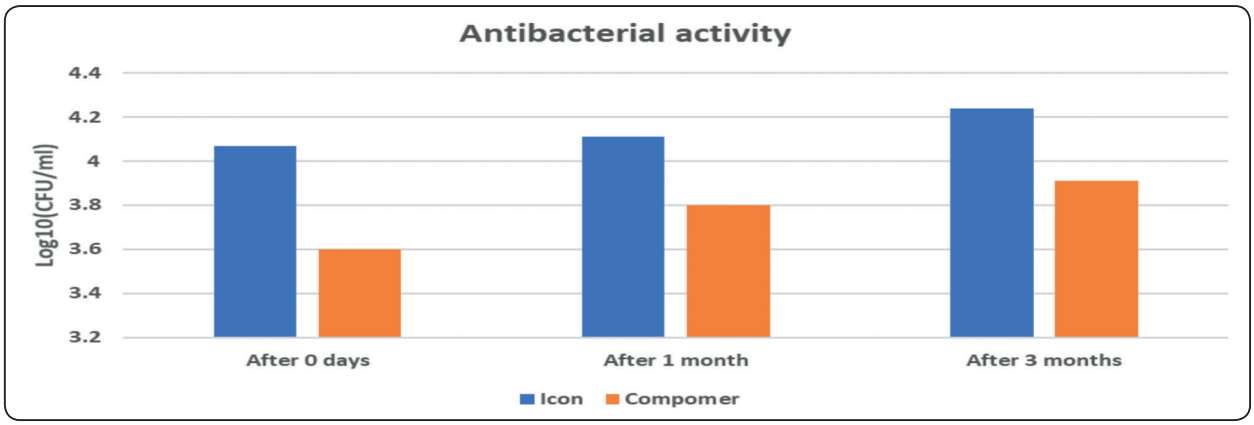

Fig. (1) Bar chart representing the antibacterial activity of the different group

TABLE (2) Comparison between the retention assessment of both Compomer and ICON groups.

Variables		Clinical				
		Icon		Compomer		p-value
		N	%	N	%	
3 months	TR	100	100%	90	90%	0.001*
	PR1	0	0%	9	9%	
	PR2	0	0%	1	1%	
	TL	0	0%	0	0%	
6 months	TR	90	90%	75	75%	0.014*
	PR1	2	2%	20	20%	
	PR2	0	0%	3	3%	
	TL	8	8%	2	2%	

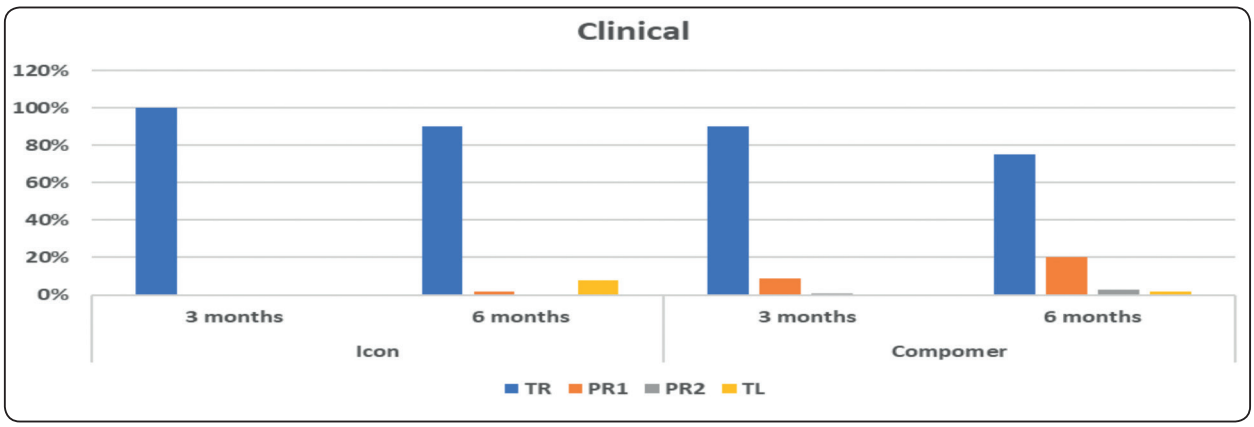

Fig. (2) Bar charts representing Comparison between the retention assessment of both Compomer and ICON groups.

DISCUSSION

The microbiological results of the present study revealed an increase in S.M. counts in both groups with time. This may be explained by the increase in plaque accumulation observed in the majority of patients after months even though oral hygiene were taught and reinforced monthly. The difficulty in permanently changing patient behavior was also reported recently by Sudjalim et al.[11]

In the current study, the rate of increase in SM counts was compared in both groups over time. A non-significant difference was found in the rate of increase of SM among the compomer group only. This might be attributed to the antibacterial activity of fluoride released from compomer in dental plaque and in agreement with the conclusion of Andre that at low concentrations, fluoride ions suppress glycosyltransferase enzyme production. Glycosyltransferase enables glucose consumption in the formation of the extracellular polysaccharide and increases bacterial adhesion. The formation of intracellular polysaccharides is prohibited by limiting microbial metabolism in hosts between meals, which prevents the accumulation of carbohydrates. As a result, the time of decay onset will be limited to the period during eating and immediately after that.[12] And also in agreement with Pinar who found that Fluoride concentrations in plaque can reach the required range, and thus able to exert inhibitory effects on oral microflora growth.[13] Where van Loveren, in his in vitro experiments have demonstrated that the acid production of S.M. and lactobacilli was reduced in layers overlying fluoridated enamel.[14] On the contrary, as the fluoride concentration decrease, the viable bacterial count increases.[13]

On the other hand, a significant difference was found between the compomer group and the ICON group after one month. This difference is in agreement with Arslan's in vitro study comparing the bacterial adhesion and count adjacent to ICON and Enamel Pro Varnish.[15]

Although a significant difference of the S.M count in both groups after one month has existed it was much less in value incomparable to that found in Hallgren et al. study. This may be contributed to that this study is designed with the concept of the split-mouth technique, which permits the crossover of fluoride from the compomer segment to the ICON segment.[16]

These results were in disagreement with Wright et al., Hong et al and Mota et al. who found no significant difference in plaque adjacent to glass ionomer compared to composite resin.[17-19] This may be contributed to that, their experiments were about the use of hybrid glass ionomer and composite resin as a bonding material for the brackets of the fixed orthodontic appliance using the split-mouth technique which causes more crossover of fluoride from hybrid glass ionomer segment to the composite segment. This might be the cause of a non-significant difference between the two materials and reduce the power of the experiment to find a difference as stated by Benson et al.[16]

Moreover, after three months, S.M counts increase in plaque adjacent to ICON more than with compomer. This result in agreement with the study conducted by Soly et al., fluoride varnish was more effective in reducing bacterial adhesion compared with resin infiltrate (ICON).[15]

The result also in agreement with Matalon et al., Duque et al., and Da Silva et al., who concluded that all glass ionomers presented significant antibacterial activity. Similarly, Corry et al., concluded that higher protection against enamel demineralization could be achieved with a glass ionomer cement supplemented with a fluoride exposure compared to a composite resin control with equivalent fluoride exposure e.g., fluoride dentifrice. [20,21,22]

In the compomer group, no significant increase in S.M counts was evident after three months period compared to the baseline value. This may be due to fluoride-releasing hybrid glass ionomer may result

in slowing down the rate of colonization by S.M and may compensate for a decrease in oral hygiene compared to non-fluoride releasing resin infiltration (ICON). The increase in SM counts after three months was much less than those observed for the ICON group on all sampling occasions after the application of both sealants. The results seem to be in agreement with Seppa et al. and Friedle et al. who concluded that hybrid glass ionomers can absorb fluoride from topical fluorides such as toothpaste or gels and subsequently release it as a rechargeable reservoir which can prolong their inhibitory effect on SM growth. [23] In the current study, the Clinical results showed a significant difference between Compoglass flow and ICON regarding the total retention, partial retention, and total loss along with the 3 and 6 months follow up periods, p value=0.001 after 3 months and 0.014 after 6 months. This explains the superior retention capability of infiltration as a fissure sealant over Polyacid-modified resin-based fissure sealants (Compomer), and this comes in agreement with Yakut et. al. who compared resin sealant vs. polyacid-modified resin composite in the two-year clinical study.[24] and in disagreement Puppin-Rontan et.al. study found no significant difference regarding total retention of both Compoglass flow versus Flouroshieled which is the resin-based sealant, after two years of study.[25]

Meanwhile, there was no significant difference within the ICON group regarding its clinical retention along the period of follow up (6 months). That might be due to using rubber-dam isolation during application and the twice application of ICON resin. These results are in agreement with Kim et al. who recommended that for the resin infiltration technique, the resin must be applied twice to compensate for polymerization shrinkage and occlude microporosities that may persist within the infiltrated lesion body.[26] It might be also due to prolonged etching time of 2 minutes with hydrochloric resulting in deep enamel pores which permit the formation of deep penetration of resin tags into the surface enamel layer. This was in agreement with Meyer et. al. who stated that application of hydrochloric acid 15% as an etchant has been demonstrated to be superior to 37% phosphoric acid gel in removing the surface layer of natural enamel when applied for 120 s. [27]

While the results of clinical retention of the compomer group showed no-significant difference regarding total retention, partial retention, and total loss after 3 months but after 6 months. In the current study, the total retention rate of Compoglass flow after 6 months was superior to the findings of Puppin-Rontan study [25] that might be due to using rubber-dam as an isolation technique in the current study while the isolation level in Puppin-Rontan et.al. study was cotton rolls and saliva ejector.[24] This was supported by the systematic review of Simonsen in 2002 who found that clinical evaluation of the retention and quality of 2 fluoride-releasing sealants suggests that placement under rubber dam increases retention rate and sealant quality and may reduce material-dependent factors that are considered a cause of sealant failures.[28]

CONCLUSION

Compomer (Compoglass flow) has a superior antibacterial effect against Streptococcus mutans superior to resin infiltration (ICON).

Resin infiltration (ICON) has better clinical retention as a fissure sealant than Compomer (Compoglass flow).

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